

# CD4035BM/CD4035BC 4-Bit Parallel-In/Parallel-Out Shift Register

## General Description

The CD4035B 4-bit parallel-in/parallel-out shift register is a monolithic complementary MOS (CMOS) integrated circuit constructed with P- and N-channel enhancement mode transistors. This shift register is a 4-stage clocked serial register having provisions for synchronous parallel inputs to each stage and serial inputs to the first stage via JK logic. Register stages 2, 3, and 4 are coupled in a serial "D" flip-flop configuration when the register is in the serial mode (parallel/serial control low).

Parallel entry via the "D" line of each register stage is permitted only when the parallel/serial control is "high".

In the parallel or serial mode, information is transferred on positive clock transitions.

When the true/complement control is "high", the true contents of the register are available at the output terminals. When the true/complement control is "low", the outputs are the complements of the data in the register. The true/complement control functions asynchronously with respect to the clock signal.

$\overline{JK}$  input logic is provided on the first stage serial input to minimize logic requirements particularly in counting and sequence-generation applications. With  $\overline{JK}$  inputs connected together, the first stage becomes a "D" flip-flop. An asynchronous common reset is also provided.

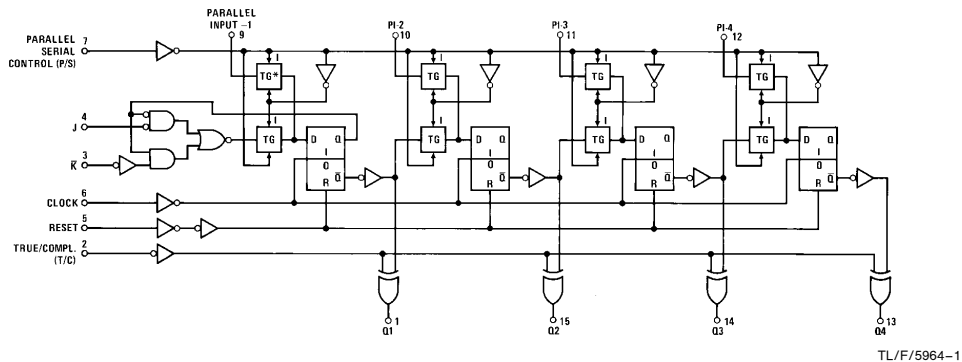
## Features

- Wide supply voltage range 3.0V to 15V
- High noise immunity 0.45  $V_{DD}$  (typ.)
- Low power TTL compatibility Fan out of 2 driving 74L or 1 driving 74LS
- 4-stage clocked operation
- Synchronous parallel entry on all 4 stages
- JK inputs on first stage
- Asynchronous true/complement control on all outputs
- Reset control
- Static flip-flop operation; master/slave configuration
- Buffered outputs
- Low power dissipation 5  $\mu$ W (typ.) (ceramic) to 5 MHz
- High speed

## Applications

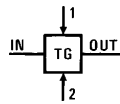
- Automotive
- Data terminals
- Instrumentation
- Medical electronics
- Alarm systems
- Industrial controls
- Remote metering
- Computers

## Logic Diagram



P/S = 0 = serial mode  
T/C = 1 = true outputs  
\*TG = transmission gate

Input to output is:  
a) A bidirectional low impedance when control input 1 is low and control input 2 is high.  
b) An open circuit when control input 1 is high and control input 2 is low.



TL/F/5964-2

CD4035BM/CD4035BC 4-Bit Parallel-In/Parallel-Out Shift Register

## Absolute Maximum Ratings (Notes 1 and 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

DC Supply Voltage ( $V_{DD}$ )	-0.5V to +18V
Input Voltage ( $V_{IN}$ )	-0.5V to $V_{DD}$ + 0.5V
Storage Temperature Range ( $T_S$ )	-65°C to +150°C
Power Dissipation ( $P_D$ )	
Dual-In-Line	700 mW
Small Outline	500 mW

Lead Temperature ( $T_L$ ) (Soldering, 10 seconds)	260°C
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## Operating Conditions (Note 2)

DC Supply Voltage ( $V_{DD}$ )	3V to 15V
Input Voltage ( $V_{IN}$ )	0V to $V_{DD}$
Operating Temperature Range ( $T_A$ )	
CD4035BM	-55°C to +125°C
CD4035BC	-40°C to +85°C

## DC Electrical Characteristics CD4035BM (Note 2)

Symbol	Parameter	Conditions	-55°C		+25°C			+125°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
$I_{DD}$	Quiescent Device Current	$V_{DD} = 5V, V_{IN} = V_{DD}$ or $V_{SS}$		5		0.3	5		150	$\mu A$
		$V_{DD} = 10V, V_{IN} = V_{DD}$ or $V_{SS}$		10		0.5	10		300	$\mu A$
		$V_{DD} = 15V, V_{IN} = V_{DD}$ or $V_{SS}$		20		1.0	20		600	$\mu A$
$V_{OL}$	Low Level Output Voltage	$ I_O  < 1.0 \mu A$								
		$V_{DD} = 5V$		0.05		0	0.05		0.05	V
		$V_{DD} = 10V$		0.05		0	0.05		0.05	V
		$V_{DD} = 15V$		0.05		0	0.05		0.05	V
$V_{OH}$	High Level Output Voltage	$ I_O  < 1.0 \mu A$								
		$V_{DD} = 5V$	4.95		4.95	5		4.95		V
		$V_{DD} = 10V$	9.95		9.95	10		9.95		V
		$V_{DD} = 15V$	14.95		14.95	15		14.95		V
$V_{IL}$	Low Level Input Voltage	$ I_O  < 1.0 \mu A$								
		$V_{DD} = 5V, V_O = 0.5V$ or $4.5V$		1.5			1.5		1.5	V
		$V_{DD} = 10V, V_O = 1.0V$ or $9.0V$		3.0			3.0		3.0	V
		$V_{DD} = 15V, V_O = 1.5V$ or $13.5V$		4.0			4.0		4.0	V
$V_{IH}$	High Level Input Voltage	$ I_O  < 1.0 \mu A$								
		$V_{DD} = 5V, V_O = 0.5V$ or $4.5V$	3.5		3.5			3.5		V
		$V_{DD} = 10V, V_O = 1.0V$ or $9.0V$	7.0		7.0			7.0		V
		$V_{DD} = 15V, V_O = 1.5V$ or $13.5V$	11.0		11.0			11.0		V
$I_{OL}$	Low Level Output Current (Note 3)	$V_{DD} = 5V, V_O = 0.4V$	0.64		0.51	0.88		0.36		mA
		$V_{DD} = 10V, V_O = 0.5V$	1.6		1.3	2.25		0.9		mA
		$V_{DD} = 15V, V_O = 1.5V$	4.2		3.4	8.8		2.4		mA
$I_{OH}$	High Level Output Current (Note 3)	$V_{DD} = 5V, V_O = 4.6V$	-0.25		-0.2	0.36		-0.14		mA
		$V_{DD} = 10V, V_O = 9.5V$	-0.62		-0.5	0.9		-0.35		mA
		$V_{DD} = 15V, V_O = 13.5V$	-1.8		-1.5	-3.5		-1.1		mA
$I_{IN}$	Input Current	$V_{DD} = 15V, V_{IN} = 0V$		-0.1		$-10^{-5}$	-0.1		-1.0	$\mu A$
		$V_{DD} = 15V, V_{IN} = 15V$		0.1		$10^{-5}$	0.1		1.0	$\mu A$

## DC Electrical Characteristics CD4035BC (Note 2)

Symbol	Parameter	Conditions	-40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
$I_{DD}$	Quiescent Device Current	$V_{DD} = 5V, V_{IN} = V_{DD}$ or $V_{SS}$		20		0.5	20		150	$\mu A$
		$V_{DD} = 10V, V_{IN} = V_{DD}$ or $V_{SS}$		40		1.0	40		300	$\mu A$
		$V_{DD} = 15V, V_{IN} = V_{DD}$ or $V_{SS}$		80		5.0	80		600	$\mu A$
$V_{OL}$	Low Level Output Voltage	$ I_O  < 1 \mu A$								
		$V_{DD} = 5V$		0.05		0	0.05		0.05	V
		$V_{DD} = 10V$		0.05		0	0.05		0.05	V
		$V_{DD} = 15V$		0.05		0	0.05		0.05	V
$V_{OH}$	High Level Output Voltage	$ I_O  < 1 \mu A$								
		$V_{DD} = 5V$	4.95		4.95	5		4.95		V
		$V_{DD} = 10V$	9.95		9.95	10		9.95		V
		$V_{DD} = 15V$	14.95		14.95	15		14.95		V

## DC Electrical Characteristics CD4035BC (Note 2) (Continued)

Symbol	Parameter	Conditions	-40°C		25°C			85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
V <sub>IL</sub>	Low Level Input Voltage	I <sub>O</sub>   < 1 μA V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.5V or 4.5V V <sub>DD</sub> = 10V, V <sub>O</sub> = 1.0V or 9.0V V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V or 13.5V		1.5 3.0 4.0				1.5 3.0 4.0		V V V
V <sub>IH</sub>	High Level Input Voltage	I <sub>O</sub>   < 1 μA V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.5V or 4.5V V <sub>DD</sub> = 10V, V <sub>O</sub> = 1.0V or 9.0V V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V or 13.5V	3.5 7.0 11.0		3.5 7.0 11.0			3.5 7.0 11.0		V V V
I <sub>OL</sub>	Low Level Output Current (Note 3)	V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.4V V <sub>DD</sub> = 10V, V <sub>O</sub> = 0.5V V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V	0.52 1.3 3.6		0.44 1.1 3.0	0.88 2.25 8.8		0.36 0.9 2.4		mA mA mA
I <sub>OH</sub>	High Level Output Current (Note 3)	V <sub>DD</sub> = 5V, V <sub>O</sub> = 4.6V V <sub>DD</sub> = 10V, V <sub>O</sub> = 9.5V V <sub>DD</sub> = 15V, V <sub>O</sub> = 13.5V	-0.2 -0.5 -1.4		-0.16 -0.4 -1.2	0.36 0.9 -3.5		-0.12 -0.3 -1.0		mA mA mA
I <sub>IN</sub>	Input Current	V <sub>DD</sub> = 15V, V <sub>IN</sub> = 0V V <sub>DD</sub> = 15V, V <sub>IN</sub> = 15V		-0.3 0.3		-10 <sup>-5</sup> 10 <sup>-5</sup>	-0.3 0.3		-1.0 1.0	μA μA

**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed, they are not meant to imply that the devices should be operated at these limits. The table of "Recommended Operating Conditions" and "Electrical Characteristics" provides conditions for actual device operation.

**Note 2:** V<sub>SS</sub> = 0V unless otherwise specified.

**Note 3:** I<sub>OH</sub> and I<sub>OL</sub> are tested one output at a time.

## AC Electrical Characteristics\*

T<sub>A</sub> = 25°C, C<sub>L</sub> = 50 pF, R<sub>L</sub> = 200k, t<sub>r</sub> and t<sub>f</sub> = 20 ns, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>CLOCKED OPERATION</b>						
t <sub>PHL</sub> , t <sub>PLH</sub>	Propagation Delay Time	V <sub>DD</sub> = 5V V <sub>DD</sub> = 10V V <sub>DD</sub> = 15V		250 100 75	500 200 150	ns ns ns
t <sub>THL</sub>	Transition Time High Low to High	V <sub>DD</sub> = 5V V <sub>DD</sub> = 10V V <sub>DD</sub> = 15V		90 50 40	175 75 60	ns ns ns
t <sub>TLH</sub>	Transition Time Low to High	V <sub>DD</sub> = 5V V <sub>DD</sub> = 10V V <sub>DD</sub> = 15V		135 70 60	270 140 120	ns ns ns
t <sub>WL</sub> , t <sub>WH</sub>	Minimum Clock Pulse Width	V <sub>DD</sub> = 5V V <sub>DD</sub> = 10V V <sub>DD</sub> = 15V	335 165 100	135 50 40		ns ns ns
t <sub>rCL</sub> , t <sub>fCL</sub>	Clock Rise and Fall Time	V <sub>DD</sub> = 5V V <sub>DD</sub> = 10V V <sub>DD</sub> = 15V			15 10 5	μs μs μs
t <sub>s</sub>	Minimum Set-up Time J/ $\bar{R}$ Lines	V <sub>DD</sub> = 5V V <sub>DD</sub> = 10V V <sub>DD</sub> = 15V		250 100 80	500 200 160	ns ns ns
t <sub>s</sub>	Parallel-In Lines	V <sub>DD</sub> = 5V V <sub>DD</sub> = 10V V <sub>DD</sub> = 15V		250 100 80	500 200 160	ns ns ns
t <sub>s</sub>	P/S Control	V <sub>DD</sub> = 5V V <sub>DD</sub> = 10V V <sub>DD</sub> = 15V		100 40 35	200 80 60	ns ns ns
f <sub>MAX</sub>	Maximum Clock Frequency	V <sub>DD</sub> = 5V V <sub>DD</sub> = 10V V <sub>DD</sub> = 15V	1.5 3 5	2.5 6 9		MHz MHz MHz

## AC Electrical Characteristics\*

$T_A = 25^\circ\text{C}$ ,  $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}$ ,  $t_r$  and  $t_f = 20\text{ ns}$ , unless otherwise specified. (Continued)

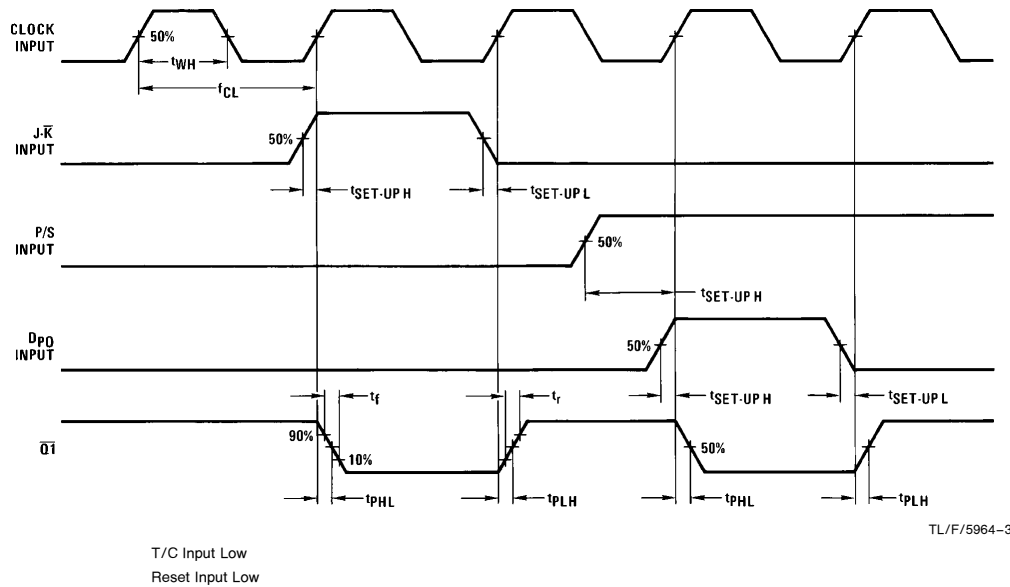
Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>CLOCKED OPERATION (Continued)</b>						
$C_{IN}$	Input Capacitance	Any Input		5	7.5	pF
<b>RESET OPERATION</b>						
$t_{PHL}$ , $t_{PLH}$	Propagation Delay Time	$V_{DD} = 5\text{V}$ $V_{DD} = 10\text{V}$ $V_{DD} = 15\text{V}$		300 150 85	500 200 150	ns
$t_{WH}$	Minimum Reset Pulse Width	$V_{DD} = 5\text{V}$ $V_{DD} = 10\text{V}$ $V_{DD} = 15\text{V}$		75 30 25	250 110 80	ns

\*AC Parameters are guaranteed by DC correlated testing.

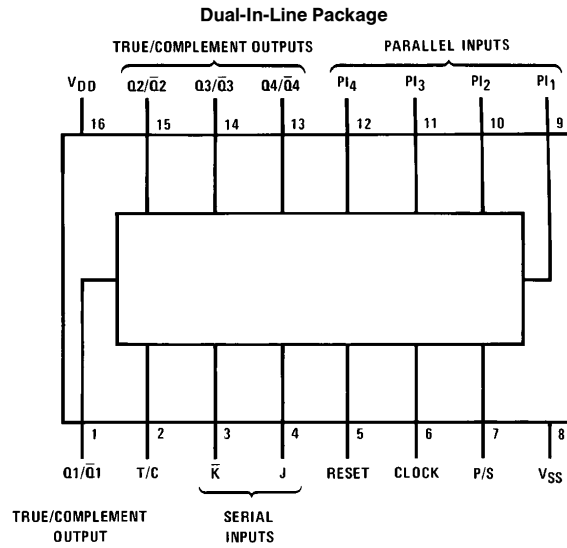
## Truth Table

$C_L$	$t_n - 1$ (Inputs)				$t_n$ (Outputs)	
	J	$\bar{K}$	R	$Q_{n-1}$	$Q_n$	
	0	X	0	0	0	
	1	X	0	0	1	
	X	0	0	1	0	
	1	0	0	$Q_{n-1}$	$\overline{Q_{n-1}}$ TOGGLE MODE	
	X	1	0	1	1	
	X	X	0	$Q_{n-1}$	$Q_{n-1}$	
X	X	X	1	X	0	

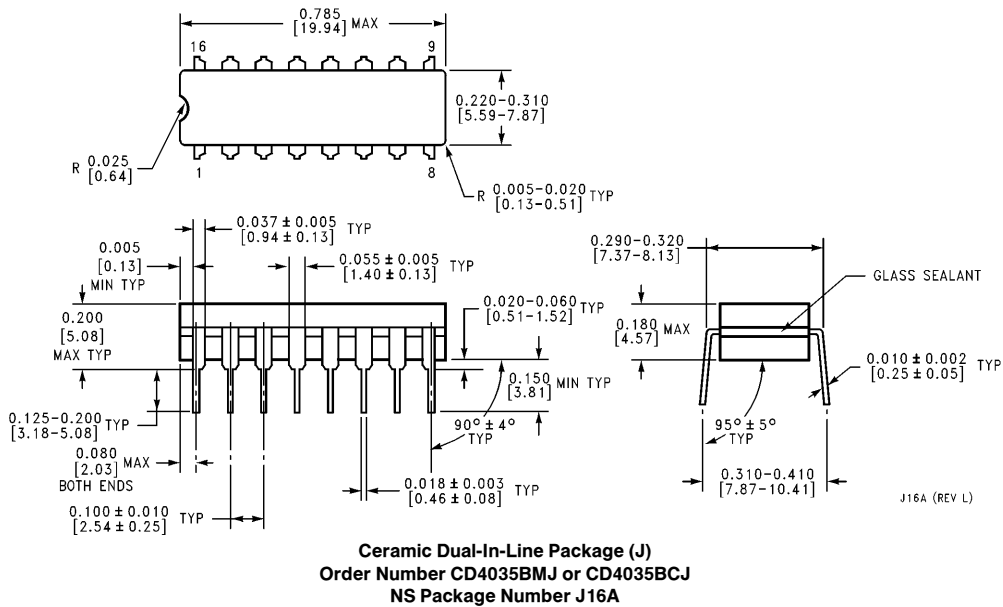
## Switching Time Waveforms



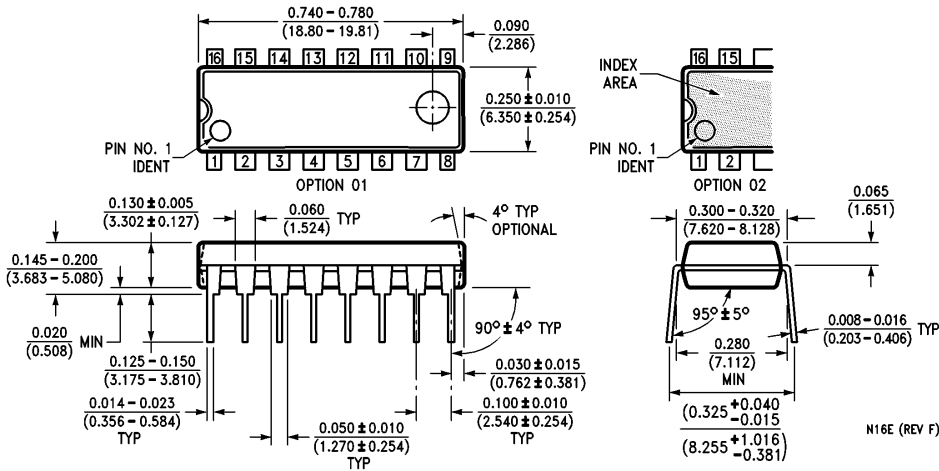
## Connection Diagram



## Physical Dimensions inches (millimeters)



**Physical Dimensions** inches (millimeters) (Continued)



**Molded Dual-In-Line Package (N)**  
**Order Number CD4035BMN or CD4035BCN**  
**NS Package Number N16E**

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**National Semiconductor Corporation**  
 1111 West Bardin Road  
 Arlington, TX 76017  
 Tel: 1(800) 272-9959  
 Fax: 1(800) 737-7018

**National Semiconductor Europe**  
 Fax: (+49) 0-180-530 85 86  
 Email: cnjwge@tevm2.nsc.com  
 Deutsch Tel: (+49) 0-180-530 85 85  
 English Tel: (+49) 0-180-532 78 32  
 Français Tel: (+49) 0-180-532 93 58  
 Italiano Tel: (+49) 0-180-534 16 80

**National Semiconductor Hong Kong Ltd.**  
 19th Floor, Straight Block,  
 Ocean Centre, 5 Canton Rd.  
 Tsimshatsui, Kowloon  
 Hong Kong  
 Tel: (852) 2737-1600  
 Fax: (852) 2736-9960

**National Semiconductor Japan Ltd.**  
 Tel: 81-043-299-2309  
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